

Interdisciplinary Research Programs in Geophysical Fluid Dynamics

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LONG-TERM GOALS

The long term goals are to train new scientists to conduct research, and to enhance the abilities of experienced research workers in geophysical fluid dynamics.

OBJECTIVES

To help graduate students formulate and tackle innovative research problems in GFD. To promote an exchange of knowledge and ideas between investigators in the different scientific disciplines that deal with the dynamics of stratified fluids, rotating fluids, fluid with phase changes and non-Newtonian fluids. To formulate tractable, important problems which are presently at the fringe of our understanding in the field of Geophysical Fluid Dynamics. To serve as a clearing-house for the mathematical, experimental and computational techniques which serve astrophysics, climate science, geodynamics, meteorology and oceanography.

APPROACH

We conduct a summer study school of ten weeks duration each summer. The participants are graduate student fellows, visiting graduate students and visiting scientists. The first two weeks consist of principal lectures in the summer's topic conducted by an expert in that area. Lectures by associated participants follow at a rate of roughly one or two per day for the remaining weeks except for the last week, when student fellows present their results. Approximately ten graduate students are admitted as Fellows. Each Fellow receives a stipend for the full ten weeks, conducts a research project under the guidance of the staff and provides a written project report. The fellows also write up the principal lectures. Several other graduate students visit for shorter periods to listen to lectures and interact with the staff. The staff (i.e. all of the visiting scientists) is continually renewed throughout the summer, although there is a core faculty who remain for the entire summer. Most of these participants receive partial travel support from the program. The lecture notes and the written report of the fellows' projects are contained in a volume that is distributed in print form and put on the Web.

WORK COMPLETED

In 2003, the theme was Non-Newtonian Flows. The lectures were given by John Hinch of the University of Cambridge. During the rest of the program, participants and visitors who have studied turbulence, convection, and instability in numerous geophysical situations with application to the

ocean, the earth's atmosphere and planetary circulation made numerous contributions with approximately 40 additional lectures.

The nine fellows selected this year were selected from a pool of applicants who are graduate students from many disciplines in their second to fourth year.

The fellows, their main interest, and their University affiliation were:

1. Alison Rust, geologist from the University of Oregon.
2. Junjun Liu, a planetary dynamicist from Caltech.
3. Joel Miller, an applied mathematician from the Department of Applied Mathematics and Theoretical Physics, University of Cambridge.
4. Christopher Wolfe, an oceanographer from Oregon State University.
5. Andrew Thompson, an oceanographer from Scripps Institute of Oceanography, U. C. San Diego.
6. Amit Apte a physicist from the University of Texas, Austin.
7. Neil Burrell, an applied mathematician from the University of Colorado.
8. Anshuman Roy, a chemical engineer from the University of Michigan.
9. Julia Mullarney, a fluid dynamicist from the Australian National University.

A number of features, such as a list of past fellows, the titles of the lectures, a list of participating scientists, and recent past volumes, are listed on the web at <http://www.whoi.edu/gfd>. Eric Chassignet, Glenn Flierl and Jean-Luc Thiffeault must be thanked for their important contributions to overseeing the computer facilities.

RESULTS

The principal lectures and fellows' reports are the tangible results. They are available as a technical report and on the web

IMPACT/APPLICATIONS

The experiences of the fellows and the staff are difficult to quantify. Many express their enthusiasm at the end of each summer. We conducted a survey two years ago for the past 20 years of fellows as part of the celebration of the 40th year of the program. About 80% of the remarks were highly complimentary. Some fellows had serious suggestions for improvement. A few of the roughly 50 responses are given here:

"I benefited a lot from the school. And overall the experience was invaluable. My criticism was that I sometimes felt that the emphasis was too heavily based on getting results (namely graphs of numerical simulations) rather than education. I found this a little bit stifling because I had open-ended ideas that I wanted to explore. And I know that the help of the staff in developing these ideas with would have been very educationally valuable to me. But, towards the end I was strongly encouraged to do things that I already knew how to do, which had less educational benefit to me."

“The GFD program is a great educational experience which introduces many talented future scientists to our field. We should make every effort to make sure it continues for many generations of new scientists. Adding more visiting lecturers can be beneficial to all.”

“The GFD faculty was, taken as a group, as good as or better than the best department anywhere. It was a real treat to be a student/fellow of this group.”

“The most valuable lesson for me was watching this accomplished group 'do science'. I learned more from interacting with them, and watching/listening to them interact with one another and with other fellows than from any specific problem or piece of research.”

“I chose the wrong project with the wrong advisor. I didn’t get much out of the summer. But, in a different situation, I definitely would have.”

The Dean’s office also has the fellows evaluate the program, and many comments are similar to those given here.

TRANSITIONS

We estimate that typically 20-50% of the student projects become included in their thesis or postdoctoral work and/or result in publications. The program does not follow the fellows' research after the summer is finished although individual staff members often remain involved with the fellows' continuation of their projects past the end of the summer.

RELATED PROJECTS

All staff members are active research workers, so numerous related projects exist.